3.3 examples

$\frac{d}{dx}(x^2 \sin x)$?

$$\frac{d}{dx}(c) = 0 \qquad \frac{d}{dx}(x^n) = nx^{(n-1)}$$

$y = x^2(x^3+1)$. Find $\frac{dy}{dx}$.

$x^5 + x^2$

$5x^4 + 2x$

$(2x)(3x^2) = 6x^3$

Kevin
Alex

$$\frac{d}{dx}\left(\overset{f}{[x^2]}\overset{g}{[x^3+1]}\right) = \overset{f'}{(2x)}\overset{g}{(x^3+1)} + \overset{f}{(x^2)}\overset{g'}{(3x^2)}$$

$$= 2x^4 + 2x + 3x^4 = 5x^4 + 2x$$

Product Rule

$$y = f(x) \cdot g(x)$$

$$(fg)' = f'g + fg'$$

$$\frac{dy}{dx} = \left[f'(x) \cdot g(x)\right] + \left[f(x) \cdot g'(x)\right]$$

Quotient Rule

$$\left(\frac{f}{g}\right)' = \frac{f'g - fg'}{(g)^2}$$

$$\cancel{\frac{x \cdot x \cdot x \cdot x \cdot x}{x \cdot x}}$$

$$\frac{d}{dx}\left(\frac{x^5}{x^2}+\frac{x^3}{x^2}\right) \xLeftarrow{\text{ALGEBRA}} \frac{d}{dx}\left(\frac{\overbrace{(x^5+x^3)}^{f}}{\underbrace{(x^2)}_{g}}\right) \xRightarrow{\text{QUOTIENT RULE}} \frac{\overbrace{(5x^4+3x^2)(x^2)}^{f'g} - \overbrace{(x^5+x^3)(2x)}^{fg'}}{(x^2)^2}$$

$$= \frac{d}{dx}\left(x^3+x\right)$$

$$\overset{\text{POWER RULE}}{=} \left(3x^2+1\right)$$

$$= \frac{(5x^6+3x^4)-(2x^6+2x^4)}{x^4}$$

$$= \frac{3x^6+x^4}{x^4} = \frac{3x^6}{x^4} + \frac{x^4}{x^4}$$

$$= 3x^2+1$$

$$\frac{d}{dx}(c) = 0$$

Power Rule $\quad \frac{d}{dx}(x^n) = nx^{(n-1)}$

$$y = x^2(x^3+1).$$

Find $\frac{dy}{dx}$

$6x^3$ 1

$\cancel{\text{HHH}}$ $5x^4 + 2x$

$$\frac{d}{dx}(x^5+x^2)$$

$$= 5x^4 + 2x$$

$$\left(\frac{d}{dx}(x^2)\right)\left(\frac{d}{dx}(x^3+1)\right)$$

$$(2x)(3x^2)$$

Product Rule

$$(fg)' = f'g + fg'$$

$$y = f(x) \cdot g(x)$$

$$\frac{dy}{dx} = \left[f'(x) \cdot g(x)\right] + \left[f(x) \cdot g'(x)\right]$$

$$\frac{d}{dx}\Big(\overset{f(x)}{x^2}\overset{g(x)}{(x^3+1)}\Big) = (2x)(x^3+1) + (x^2)(3x^2)$$

$$= 2x^4 + 2x + 3x^4$$

$$= 5x^4 + 2x$$

Quotient Rule

$$\left(\frac{f}{g}\right)' = \frac{f'g - fg'}{g^2}$$

$$\frac{d}{dy}\left(x^3 + x\right) = \frac{d}{dx}\left(\frac{x^5 + x^3}{x^2}\right) \rightarrow \frac{(5x^4 + 3x^2)(x^2) - (x^5 + x^3)(2x)}{(x^2)^2}$$

$$= 3x^2 + 1$$

$$3x^2 + 1 = \frac{3x^6 + x^4}{x^4} = \frac{5x^6 + 3x^4 - (2x^6 + 2x^4)}{x^4}$$